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EXAMINER	
DAY, HERNG DER	
ART UNIT	PAPER NUMBER
2128	

DATE MAILED: 01/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/675,908	Applicant(s) HUH ET AL.	
	Examiner Herng-der Day	Art Unit 2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 September 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *2/2/01*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This communication is in response to Applicants' Response ("Response") to Office Action dated July 12, 2004, mailed September 16, 2004.

1-1. Claims 1-18 are pending.

1-2. Claims 1-18 have been examined and rejected.

Priority

2. Applicants' claim for domestic priority under 35 U.S.C. 119(e) is acknowledged. The provisional application number is 60/159,035, filed on October 12, 1999.

Specification

3. The disclosure is objected to because of the following informalities:

Appropriate correction is required.

3-1. It appears that "(region 17 of Fig. 2)", as described in line 25 of page 14, should be "(region 17 of Figs. 3 and 4)".

4. The Examiner requests a copy of the following publication referred to in the specification because it appears to be reasonably necessary to the examination of this application and cannot be found.

(1) Nghiem, L. X., Li, Y. K. and Agarwal, R. K., "A Method for Modeling Incomplete Mixing in Compositional Simulation of Unstable Displacements," SPE 18439, presented at the

1989 Reservoir Simulation Symposium, Houston, TX, February 6- 8, 1989, referred to in line 29 of page 6 through line 2 of page 7.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. Claims 1-15 and 17 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

6-1. Claim 1 recites the limitation "(b) dividing at least some of the gridcells into two or more regions" in line 1 of step (b). However, if some of the gridcells have been divided into more than two regions it is unclear for one skilled in the art how to practice step (c) because only two regions have been defined in step (b). In other words, without undue experimentation, it is unclear for one skilled in the art how to, for example, construct a model representative of component transport rate between regions because only two regions have been defined in step (b). The remaining regions have not been defined.

6-2. Claim 1 recites the limitation "constructing a model representative of … component transport rate between regions" in step (c) of the claim. As described at page 14 of the specification, lines 20-22, "In simulation operations, flow of fluid between gridcells would be assumed to take place between gridcell nodes, or, stated another way, through inter-node

connections", and lines 26-27, "There are no inter-node connections between resident region 16 and invaded region 17". Therefore, without undue experimentation, it is unclear for one skilled in the art how to construct a model representative of component transport rate between regions because there is no flow of fluid between regions in the simulation operations.

6-3. Claim 14 recites the limitation "constructing a model comprising ... functions representative of the mass transfer of each component between the regions" in step (c) of the claim. As described at page 14 of the specification, lines 20-22, "In simulation operations, flow of fluid between gridcells would be assumed to take place between gridcell nodes, or, stated another way, through inter-node connections", and lines 26-27, "There are no inter-node connections between resident region 16 and invaded region 17". Therefore, without undue experimentation, it is unclear for one skilled in the art how to construct a model comprising functions representative of the mass transfer of each component between the regions because there is no flow of fluid between regions in the simulation operations.

6-4. Claim 17 recites the limitation "the model is representative of ... component transport between regions" in lines 1-3 of the claim. As described at page 14 of the specification, lines 20-22, "In simulation operations, flow of fluid between gridcells would be assumed to take place between gridcell nodes, or, stated another way, through inter-node connections", and lines 26-27, "There are no inter-node connections between resident region 16 and invaded region 17". Therefore, without undue experimentation, it is unclear for one skilled in the art how to have a model representative of component transport between regions because there is no flow of fluid between regions in the simulation operations.

6-5. Claims not specifically rejected above are rejected as being dependent on a rejected claim.

7. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. Claims 1-18 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

8-1. Claim 1 recites the limitation "the reservoir" in line 4 of the claim. There is insufficient antecedent basis for this limitation in the claim.

8-2. Claim 2 recites the limitation "the fluids" in line 2 of the claim. There is insufficient antecedent basis for this limitation in the claim.

8-3. Claim 13 recites the limitation "the driving force" in line 2 of the claim. There is insufficient antecedent basis for this limitation in the claim.

8-4. Claim 14 recites the limitations "the solvent" in line 7 of the claim and "the mobility of each phase", "the phase behavior" and "the mass transfer of each component" in step (c) of the claim. There is insufficient antecedent basis for these limitations in the claim.

8-5. Claim 15 recites the limitation "the reservoir and the fluids" in lines 2-3 of the claim. There is insufficient antecedent basis for this limitation in the claim.

8-6. Claim 16 recites the limitations "said model" in line 3 of the claim and "the mobility of fluids" and "the characteristic" in step (c) of the claim. There is insufficient antecedent basis for these limitations in the claim.

8-7. Claim 18 recites the limitations "the displacement fluid" in lines 6-8 of the claim and "the mobility of fluids" in lines 9-10 of the claim. There is insufficient antecedent basis for these limitations in the claim.

8-8. Claims not specifically rejected above are rejected as being dependent on a rejected claim.

Claim Rejections - 35 USC § 101

9. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

10. Claims 1-17 are rejected under 35 U.S.C. 101 because the inventions as disclosed in claims are directed to non-statutory subject matter.

10-1. Regarding claims 1-17, it is not tangibly embodied because it could be practiced with pencil and paper. Therefore, it is not in the technology arts.

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. Claims 1-4, 10-12, and 14-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over King, "The Mathematics of Oil Recovery", Clarendon Press, Oxford, 1992, pages 116-150,

in view of Meakin et al., "Simulations of One- and Two-Phase Flow in Fractures", November 1996, pages 1-18.

12-1. Regarding claim 1, King discloses a method for simulating one or more characteristics of a multi-component, hydrocarbon-bearing formation wherein a fluid comprising at least one component is injected into the formation through at least one well to displace hydrocarbons in the reservoir, comprising the steps of:

(a) equating the formation in at least one dimension to a multiplicity of gridcells (100 x 20 grid, page 142, paragraph 3);

(b) dividing at least some of the gridcells into two or more regions, a first region representing a portion of each gridcell swept by the displacement fluid and a second region representing a portion of each gridcell essentially unswept by the injected fluid, the distribution of components in each region being essentially uniform (two zones, page 133, paragraph 3);

(c) constructing a model representative of fluid properties within each region, fluid flow between gridcells, and component transport rate between regions (Eq (7.1)-(7.6)); and

(d) using the model to simulate one or more characteristics of the formation (for example, using Eq (7.5) to obtain total composition C_{ic} in the contacted region, page 136).

King fails to disclose modeling fluid flow between gridcells using principles of percolation theory.

Percolation theory is well known techniques for describing diffusion and flow in disordered heterogeneous systems. For example, Meakin et al. disclose using a modified site invasion percolation model to simulate the slow displacement of a wetting fluid by an invading non-wetting fluid (page 3, last paragraph).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of King to incorporate the teachings of Meakin et al. to obtain the invention as specified in claim 1 because percolation theory is well known and Meakin et al. have suggested using it for simulating displacement of a wetting fluid by an invading non-wetting fluid.

12-2. Regarding claim 2, King further discloses step (d) predicts a property of the formation and the fluids it contains as a function of time (for example, using Eq (7.5) to obtain total composition C_{ic} in the contacted region at each time step, page 136).

12-3. Regarding claim 3, Meakin et al. further disclose the displacement fluid is miscible with hydrocarbons in the formation (miscible displacement, page 2, paragraph 3).

12-4. Regarding claim 4, Meakin et al. further disclose the displacement fluid is multiple-contact miscible with hydrocarbons present in the formation (Two-Phase flow, page 3, section 2).

12-5. Regarding claim 10, Meakin et al. further disclose the gridcells are three-dimensional (3D-lattice, page 8, last second paragraph).

12-6. Regarding claim 11, Meakin et al. further disclose the gridcells are two-dimensional (two-dimensional lattice, page 9, paragraph 2).

12-7. Regarding claim 12, Meakin et al. further disclose the model further takes into account component diffusion, dispersivity, and interfacial tension within each region (diffusion, dispersion, and convective mass transport, page 8).

12-8. Regarding claim 14, King discloses a method for simulating one or more characteristics of a multi-component, hydrocarbon-bearing formation into which a displacement fluid is injected to displace formation hydrocarbons present in the formation, comprising

(a) equating at least part of the formation to a multiplicity of gridcells (100 x 20 grid, page 142, paragraph 3);

(b) dividing each gridcell into two regions, a first region representing a solvent-swept portion of each gridcell and a second region representing a portion of each gridcell essentially unswept by the solvent, the fluid composition within each region being essentially uniform (two zones, page 133, paragraph 3);

(c) constructing a model comprising functions representative of the mobility of each phase in each region, functions representative of the phase behavior within each region, and functions representative of the mass transfer of each component between the regions (Eq (7.1)-(7.6)); and

(d) using the model in a simulator to simulate production of the formation and to determine one or more characteristics thereof (for example, using Eq (7.5) to obtain total composition C_{ic} in the contacted region, page 136).

King fails to disclose modeling the mobility of each phase in each region using principles of percolation theory.

Percolation theory is well known techniques for describing diffusion and flow in disordered heterogeneous systems. For example, Meakin et al. disclose using a modified site invasion percolation model to simulate the slow displacement of a wetting fluid by an invading non-wetting fluid (page 3, last paragraph).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of King to incorporate the teachings of Meakin et al. to obtain the invention as specified in claim 14 because percolation theory is well known and Meakin et al. have suggested using it for simulating displacement of a wetting fluid by an invading non-wetting fluid.

12-9. Regarding claim 15, King further discloses steps (a) through (d) are repeated for a plurality of time intervals and using the results to predict a property of the reservoir and the fluids it contains as a function of time (for example, using Eq (7.5) to obtain total composition C_{ic} in the contacted region at each time step, page 136).

12-10. Regarding claim 16, King discloses a system for determining one or more characteristics of a multi-component, hydrocarbon-bearing formation into which a displacement fluid having at least one component is injected to displace formation hydrocarbons, said model using a multiplicity of gridcells being representative of the formation, comprising

(a) a model having each gridcell divided into two regions, a first region representing a portion of each gridcell swept by the displacement fluid and a second region representing a portion of each gridcell essentially unswept by the displacement fluid, the distribution of components in each region being essentially uniform (two zones, page 133, paragraph 3); and

(b) a simulator, coupled to said model, to simulate the formation to determine the characteristic therefrom (for example, using Eq (7.5) to obtain total composition C_{ic} in the contacted region, page 136).

King fails to disclose the mobility of fluids in each region being determined based on principles of percolation theory.

Percolation theory is well known techniques for describing diffusion and flow in disordered heterogeneous systems. For example, Meakin et al. disclose using a modified site invasion percolation model to simulate the slow displacement of a wetting fluid by an invading non-wetting fluid (page 3, last paragraph).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of King to incorporate the teachings of Meakin et al. to obtain the invention as specified in claim 16 because percolation theory is well known and Meakin et al. have suggested using it for simulating displacement of a wetting fluid by an invading non-wetting fluid.

12-11. Regarding claim 17, King further discloses the model is representative of fluid properties within each region, fluid flow between gridcells, and component transport between regions (Eq (7.1)-(7.6)).

12-12. Regarding claim 18, King discloses a method of simulating at least one component of a multicomponent fluid system in a hydrocarbon-bearing formation, whose characterizing features are described by a set of equations, by means of a simulator on a computer, the method comprising the steps of:

(a) providing a model having each gridcell divided into two regions, a first region representing a portion of each gridcell swept by the displacement fluid and a second region representing a portion of each gridcell essentially unswept by the displacement fluid, the distribution of components in each region being essentially uniform (two zones, page 133, paragraph 3); and

(b) using in the simulator the model thereby simulating changes of the component in the formation (for example, using Eq (7.5) to obtain total composition C_{ic} in the contacted region, page 136).

King fails to disclose the mobility of fluids in each region being determined based on principles of percolation theory.

Percolation theory is well known techniques for describing diffusion and flow in disordered heterogeneous systems. For example, Meakin et al. disclose using a modified site invasion percolation model to simulate the slow displacement of a wetting fluid by an invading non-wetting fluid (page 3, last paragraph).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of King to incorporate the teachings of Meakin et al. to obtain the invention as specified in claim 18 because percolation theory is well known and Meakin et al. have suggested using it for simulating displacement of a wetting fluid by an invading non-wetting fluid.

13. Claims 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combined teachings of King, "The Mathematics of Oil Recovery", Clarendon Press, Oxford, 1992, pages 116-150, and Meakin et al., "Simulations of One- and Two-Phase Flow in Fractures", November 1996, pages 1-18, as applied to claim 1 above, and further in view of Oswald et al., U.S. Patent 4,860,828 issued August 29, 1989.

13-1. Regarding claims 5 and 6, King fails to disclose the displacement fluid is carbon dioxide or hydrocarbon gas.

Oswald et al. disclose using supercritical fluid for recovering the residual oil after primary recovery. Examples of gases which can exist as supercritical fluid include carbon dioxide and mixtures of aliphatic hydrocarbons.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the combined teachings of King and Meakin et al. to incorporate the teachings of Oswald et al. to obtain the invention as specified in claims 5 and 6 because Oswald et al. suggest using supercritical fluid, for example, carbon dioxide or hydrocarbon gas, for recovering the residual oil after primary recovery is a well known common method.

Applicants' Arguments

14. Applicants argue the following:

(1) "Nowhere does Talwani or Oswald teach a method for constructing a model representative of fluid properties in sub-gridcell regions" (page 4, paragraph 1, Response).

(2) "Nowhere does Talwani teach the division of a large gridcell into a network of smaller gridcells to represent the fine-scale distribution of fluids within the large gridcell and then using any of the specific known techniques of percolation theory to represent viscous fingering and channeling in large gridcells in a subterranean reservoir simulation model. Nor does Oswald discuss or suggest this topic" (page 5, paragraph 3, Response).

(3) "Nowhere does either Talwani or Oswald teach a method for modeling the rate of transport of components between two gridcell regions in a subterranean reservoir simulation model when the component have unequal concentrations in the two regions" (page 6, paragraph 1, Response).

Response to Arguments

15. Applicants' arguments have been fully considered but are moot in view of the new ground(s) of rejection. The rejections of claims 1-18 under 35 U.S.C. 103(a) in Office Action dated July 12, 2004, have been withdrawn. A new ground(s) of rejection under 35 U.S.C. 103(a) is made, as detailed in sections **11** to **13-1** above.

Conclusion

16. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Herng-der Day whose telephone number is (571) 272-3777. The Examiner can normally be reached on 9:00 - 17:30.

If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, Jean R. Homere can be reached on (571) 272-3780. The fax phone numbers for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Herng-der Day H.D.
January 24, 2005

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